CURSORY OBSERVATIONS

ON THE

SEVERAL MODES NOW IN USE

OF

MANUFACTURING CABLES, HAWSERS,

AND

OTHER CORDAGE FOR NAUTICAL USES,

BY THE

PATENTEE

OF THE

SALVAGEE SYSTEM.

LONDON:

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1800.

PREFACE.

HIS Majeſty having moſt graciouſly been pleaſed to grant unto me His Royal Letters Patent for the Manufacture of Cordage on a new Principle, differing eſſentially from the one in common Uſe, it becomes neceſſary to explain it. The Specification of the Patent has been publiſhed in the Repertory of Arts, at the requeſt of the Publiſhers, in October, 1799; but as the Deſcription there, in that Mode, is formal and limited, I thought it might be of Uſe to expatiate further on the Subject, and accompany the Obſervations with explanatory Plates. This led to ſome curſory Obſervations on other Modes of making Cordage for nautical Purpoſes, and to accompany them with my own, that a comparative View might be taken of them all.

I have alſo taken the Liberty to differ with the Authority of the Marine Dictionary on the Orthography of the epithet *Selvagee:* it is generally pronounced by Seamen, *Salvagee*; and underſtood by them as deriving its Etymology from the Italian word *Salvo;** an Etymology much more appropriate than the other.

* *Safe* or *ſure.*

PREFACE.

INTRODUCTION.

IT muſt be allowed, that, among the many Arts neceſſary to Navigation, the one on which the Safety of Commerce ſo frequently depends for Security, (the manufacture of Cordage,) if not the moſt intricate and meritorious as to mental Exertion, is as important, in its Conſequences, as thoſe which are derived from the moſt refined and abſtruſe Science. The Mechanic is but ſecondary to the Philoſopher; yet the one without the Aid of the other, would yield little ſterling Good to the Community. To the enlightened Minds of *Newton*, *Napier*, *Hadley*, and others, are we indebted for the Science of conducting our commercial Intercourſe to and from all Parts of the known World; like that inviſible Phænomenon, that kindly points towards the Pole, they furniſh the Navigator with the Means of aſcertaining his Situation in all the Regions of the Globe, and of directing his Courſe from Shore to Shore, and from Port to Port. On a ſecondary Scale may be conſidered the ingenious Mechanic, by whoſe Art and Induſtry are produced thoſe ſtupendous Structures which Cuſtom has made ſo familiar, and that we now regard as common; but, abſtractly conſidered, are wonderful Proofs of human Exertion and Skill; Structures which excel, in every Point of View, the Egyptian Pyramid, the lofty Dome, or the moſt elevated Column; Works of Art, that honor the Rank of Man in the Creation, and are as uſeful as magnificent, bringing together the Inhabitants of the moſt diſtant Regions, and effecting a friendly Intercourſe between Nation and Nation throughout the Globe.

Every

Every Attempt to improve any Branch of the mechanic Arts, needful to one of theſe now neceſſary Structures, muſt be deemed laudable, and, if attended with Succeſs, muſt be of general Good.

Of every Appendage needful to the Security and Welfare of a Ship, it muſt be admitted, that the Ground-tackle is as important as any other Branch. It often happens, that, coaſting on a lee Shore, the Salvation of Ship, Crew, and Cargo, depends on the good Qualities of the Cable alone. It has often happened moſt unaccountably, that Ships have parted their Cables without any viſible or apparent Cauſe; even thoſe that have been manufactured with the utmoſt Care, and where no Expence has been ſpared to procure the beſt Materials. Cables of this Deſcription have been known to fail; and fatal Effects have often been the reſult of unknown Cauſes; Cauſes which have originated in our Ignorance of, and want of due Attention to, this important Branch of naval Security.

This Art, by ſome ſtrange Fatality, has not hitherto ſufficiently attracted the Notice and Attention of the Mathematician or Philoſopher, neither in this Country, or any Part of the maritime World*.

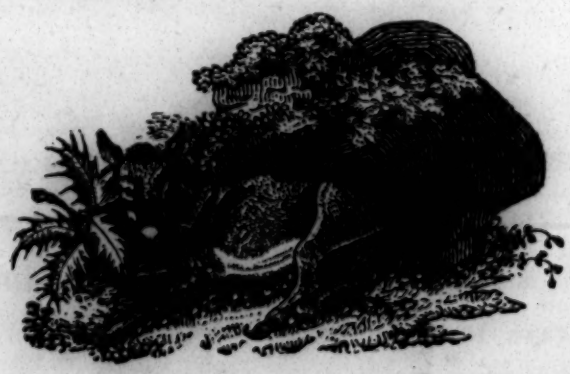
As a Proof that we have not yet been enlightened, a Syſtem is continued to this Day manifeſtly erroneous†. In order to prove this, let us take a View

* I do not mean to imply that Philoſophers have never taken it into Contemplation, or have wholly diſregarded it: ſome have made miniature Experiments; others have taken it up in Error. *Monſieur L'Abbé Reaumer*, for example: he ſays, "In his Experiments to decide what could be urged for and againſt *Twiſting*; the Reſult was, that, *contrary to all Expectation*, he ſtill found that Twiſting diminiſhed the Strength of the Rope."

† A Syſtem which has undoubtedly been often the Cauſe of thoſe fatal Effects before alluded to.

View of the manufacture of a Cable, in its earlieſt Stage of Progreſs. A conſiderable Body of Yarns, of equal Lengths, are ſtretched horizontally, brought together at the Extremities, and then combined or united with circular Turn at each End; 'tis evident, that as this circular Motion converts them into a cylindrical Form, that the Yarns will ſubtend unequal (but not progreſſive) Radii; the outſide ones will circumſcribe large Circles, and the inſide ones ſmall Circles: by ſuch a Proceſs 'tis clear, that the Bearings of the ſeveral Yarns are unequal to a very conſiderable Extent: To this Inequality is to be aſcribed all the Evils complained of.

To remedy this Defect as nearly as poſſible, and alſo to combine every other Property required, will be to attain the Deſideratum of this Art. This Remedy is now attempted by two diſtinct Syſtems, differing from the one in Practice, and alſo from each other: The ſucceeding Treatiſe, with Plates, &c. is intended to elucidate and explain them.



OBSERVATIONS.

IN this art, as in others, certain data muſt be taken or admitted, from whence concluſions may reſult: I therefore take it for granted, as a received and acknowledged hypotheſis, that a combination of yarns, united in parallels to each other, have the greateſt power from their vertical direction to ſuſpend weights: That when converted into ſpirals, by a rotation on the axis of a cylinder, they loſe or diminiſh that power in proportion as the ſpirals contract: That a ſtrong adheſion is neceſſary to combine and unite the ſeveral twiſts or diviſions of a rope, and that this adheſion cannot be attained, otherwiſe than by the re-action of the parts; and alſo, that this re-action ſhould be gradual and progreſſive; not rapid.

From theſe premiſes it follows, that the ſyſtem which makes the neareſt approach to perfection, will be that which beſt combines theſe properties, with the neareſt equality of bearing in the ſeveral yarns that compoſe the cable or rope.

The method hitherto in practice for ages paſt, has been by a Syſtem that may be defined WRINGING; that is, by yarns placed parallel and horizontal, and then acted on by circular turn at the extremities. The cylinder thus produced has all the properties required, except *equality of bearing*, or acting together. Such cylinder being unravelled, or *hove back*, will exhibit the appearance deſcribed in *Plate* 1. *Fig.* 2. On the ſlighteſt view, the error is ſo apparent, as to render any comment or explanation uſeleſs.

A ſecond Syſtem has been lately introduced, which may be defined WINDING.

Plate 3, *Fig.* 2,* exhibits yarns, or diviſions of yarns, paſſing through a number of holes (from the ſtationary board *g*) ſurrounding a center one, which, by the circular and receding movements of the powers *e* and *d*, compreſſed at the point *f*, come forth in progreſſive ſpirals wound round each other, forming a regular cylinder, and in this ſtate have the greateſt poſſible ſtrength; as each ſubtends progreſſive radii, and all act together: but this twiſt, when thus obtained, is nearly dormant, or neutral; and without the required re-action to combine it with others; to obtain which, recourſe is had to circular turn on its axis from the extremities. The adheſion thus obtained is rapid.

The third Syſtem is by ſubdividing the component parts.†

Plate 2,

* This Plate is meant to exhibit the Syſtem only: the Apparatus for carrying it into Execution, may be known by a reference to the Specifications of the ſeveral Patentees, or on View at His Majeſty's Yards.

† This Syſtem has by ſome been ſlighted for its ſimplicity. Men are ſometimes dazzled by complexity. A ſplendid piece of mechaniſm attracts notice, and raiſes our admiration to a conſiderable degree. A few years ſince, trial was made to manufacture cables, not on any change of ſyſtem, but by a ſplendid and coſtly apparatus. Much ingenuity was diſplayed by the artiſt: but, after all, its power was to effect nothing more than could be performed by the *handle of a grindſtone*. Nature, in her operations, acts with ſimplicity: we always find her ſo, particularly in the great ſcheme of the ſolar ſyſtem. Let us place the Britiſh Poet's Indian in the act of contemplating the various revolutions of the day, the night, and the ſeaſons, and at a loſs to conceive how this great luminary can appear in ſuch varied poſitions; place by his ſide a European Philoſopher, who, by plucking an orange from the pendent branch, would reſolve them all, by ſhewing the motions which produce theſe wonderful effects: How would the aſtoniſhed Indian feel, to learn that the great Author of the univerſe performed all that had attracted his wonder and ſurprize by only two revolving motions!

Plate 2, *Fig.* 2, exhibits theſe Subdiviſions. The Specification of the Patent here annexed, ſo amply deſcribes them, as to leave little more than to note, that each ſubdiviſion, or ſalvagee ſtrand, retains, thro' the whole proceſs, the ſpiral direction in which it is firſt placed; that the ſpirals are neither diſturbed or diſtorted through all their changes; they act uniformly together in ſimilar curvatures: and a cable or rope thus conſtructed, is neither more nor leſs than a combination of ſtrands in lengthened ſpirals; conſequently are formed, and put together, from powers, but fractionally inferior to a combination of yarns placed parallel to each other.

And, laſtly, a fourth Syſtem may be introduced, by making each thread, or diviſion of them, circumſcribe equal radii. *

In theſe four diſtinct Syſtems, or modes, will be comprized every change that can take place in the twiſt of a cable: it may, therefore, be aſſerted, with ſome propriety, every poſſible mode of manufacturing cordage with the properties required for nautical uſes.

To elucidate what has been advanced on the three Syſtems now in practice, the Plates, &c. will convey information in a more eaſy and comprehenſive manner than the moſt elaborate explantion.†

* Some miniature Experiments, with a ſpiral Top, have been made by *Mr. Mitchell, Jun.* it may probably be acted on.

† The Engravings are ſufficiently correct for the purpoſes meant. In ſome inſtances they may be ſubject to profeſſional Criticiſm, eſpecially in *Plate* 3, *Fig.* 1. It will, I hope, be ſome apology in their favour, when it's known they are from the drawings of a School Boy during his Chriſtmas receſs.

DESCRIPTION OF THE PLATES.

Plate 1, *Fig.* 1, repreſents one of the twiſts of a cable on the WRINGING Syſtem, hove up by circular turn on its axis to its full *hard;* that is, to its utmoſt contraction. This twiſt is conſiderably diſtorted, which artiſts call *cockling*. The figures *a* and *c* are powers acting on *cranks*, to effect circular turn on its axis. The poſts and board at *Fig. c*, are ſtationary: the poſts and board at *Fig. a*, are moveable: the caſks are weighty, being filled with denſe matter, to keep the twiſt ſtraight, and prevent its *kinking*.

Fig. 2, exhibits the twiſt when unravelled, that is, with the ſpiral turn hove out. The powers *e* and *f* are in the attitude of reverſing what they had before performed; whilſt the power at *d* is co-operating by the act of pulling back the ſledge or moveable poſts at *e*. The looſe yarns hanging in oval directions, are thoſe that formed the external of the twiſt.

Plate 2, *Fig.* 1, repreſents one of the twiſts of a cable on the Subdiviſion or SALVAGEE Syſtem, acted on by circular turn on its axis, and hove up to its full *hard,* by a ſimilar proceſs as deſcribed in *Plate* 1, *Fig.* 1. This twiſt is much more cylindrical; the indents and diſtortions are inconſiderable; and, if carefully attended to, will form a regular and ſmooth cylinder.

Fig. 2. Exhibits this twiſt (in four ſubdiviſions) when unravelled; that is, with the ſpiral turn hove out. Contraſt it with *Fig.* 2, *Plate* 1, the difference between them will be manifeſt.

Plate 3,

Plate 1

Fig. 1

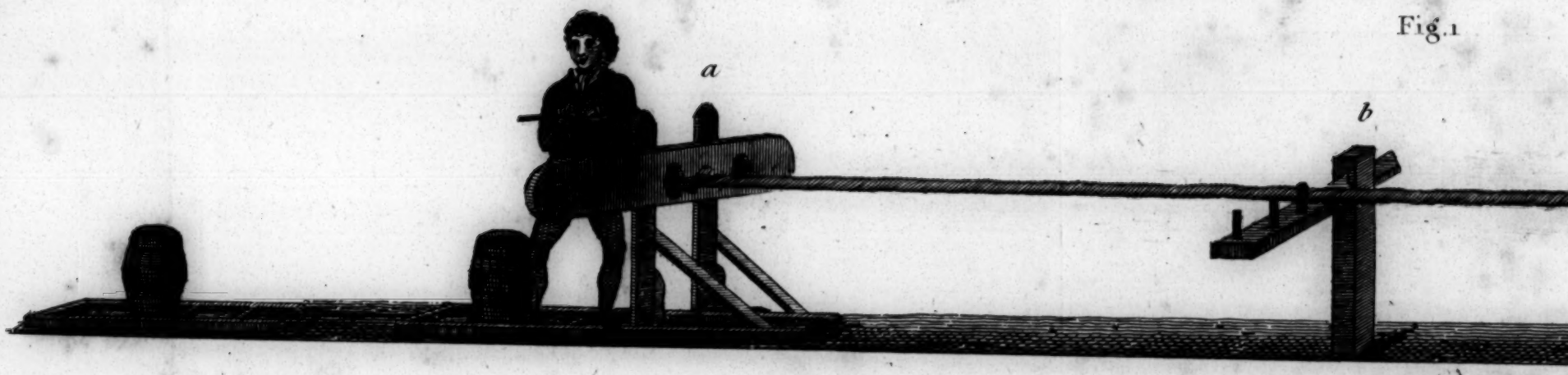
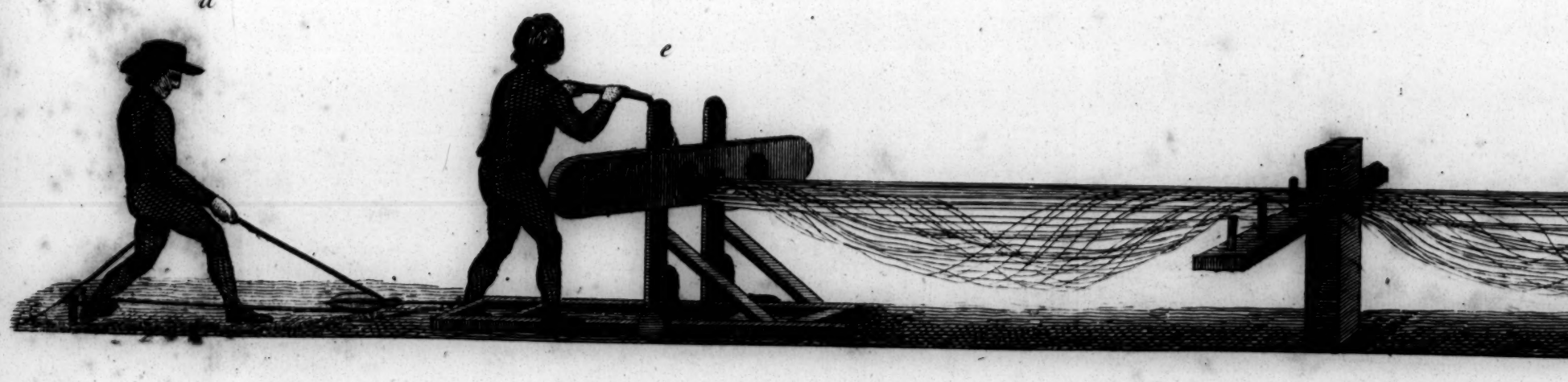
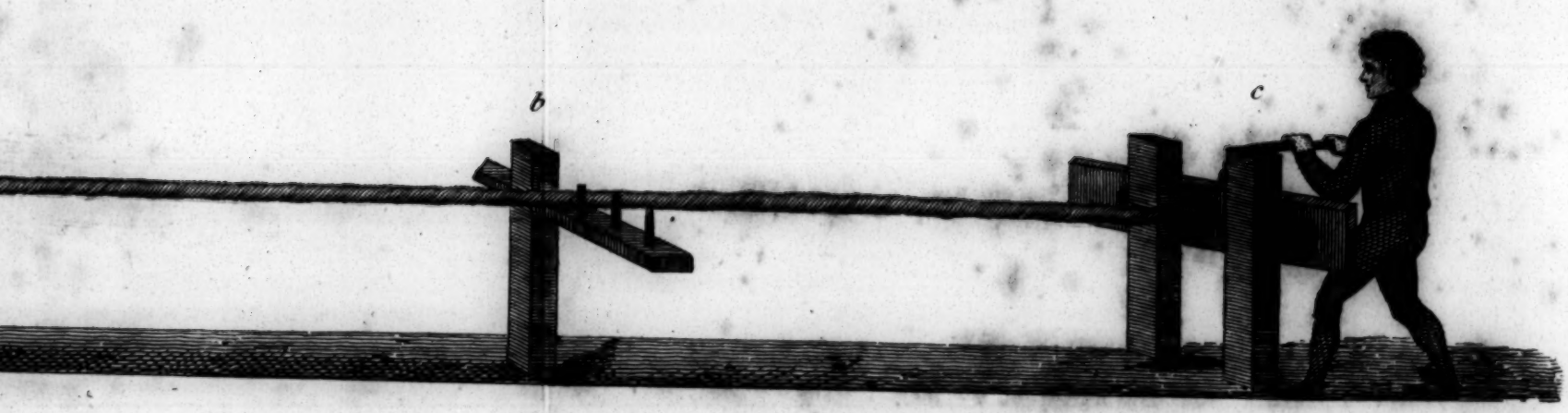
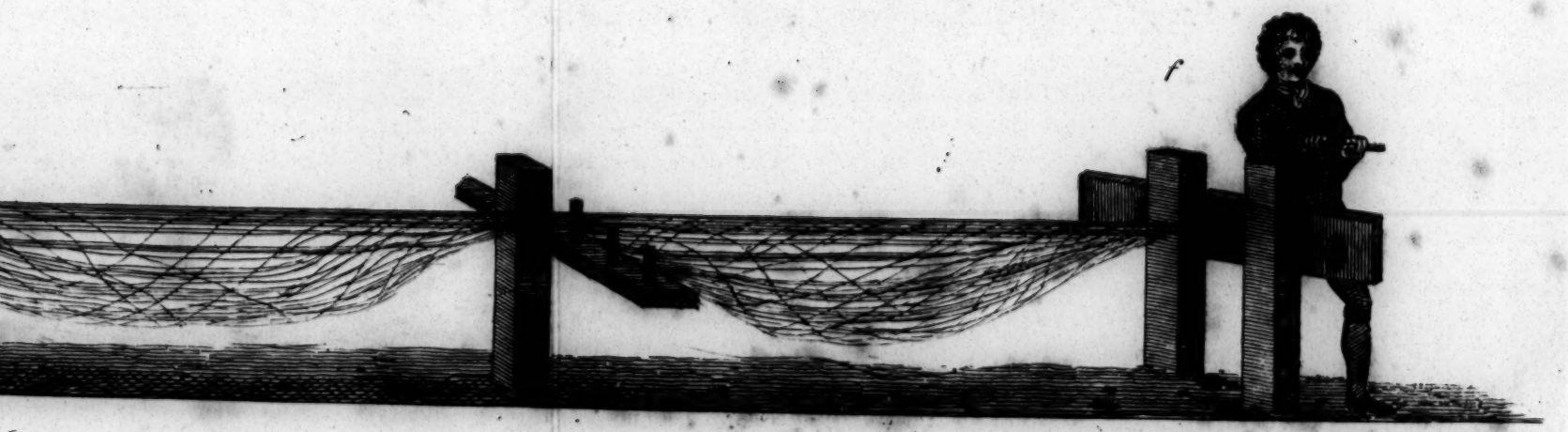


Fig. 2







Veele sc. Strand.

Plate 2.

Fig. 1

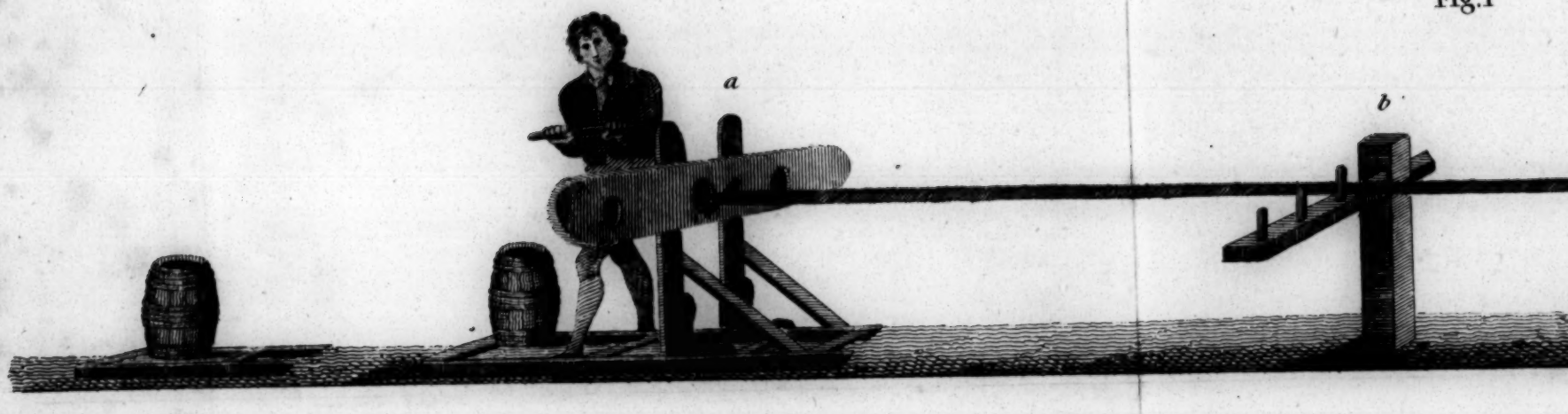


Fig. 2

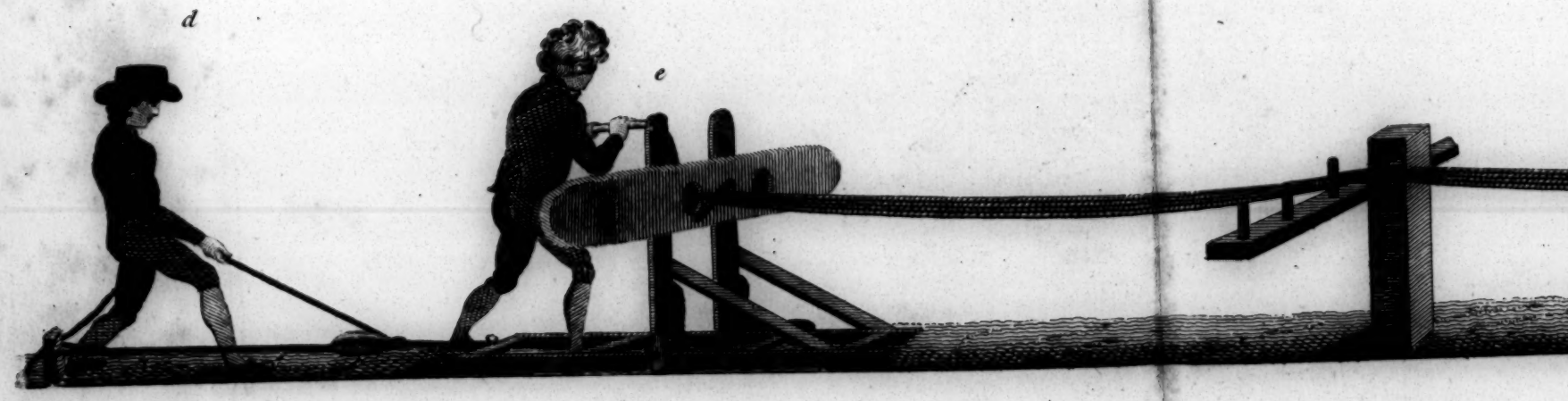


Fig.1

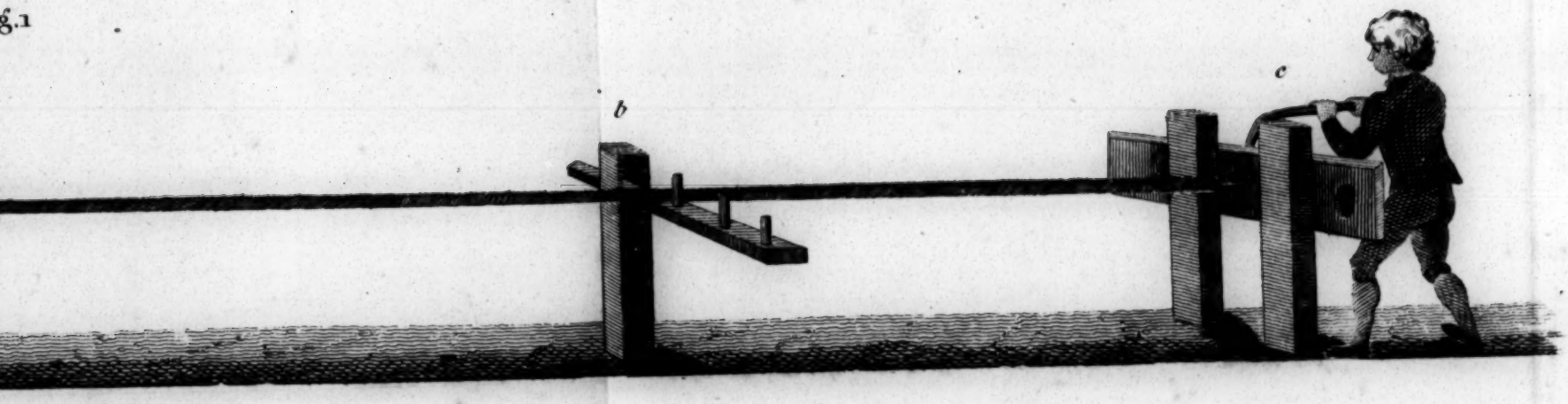
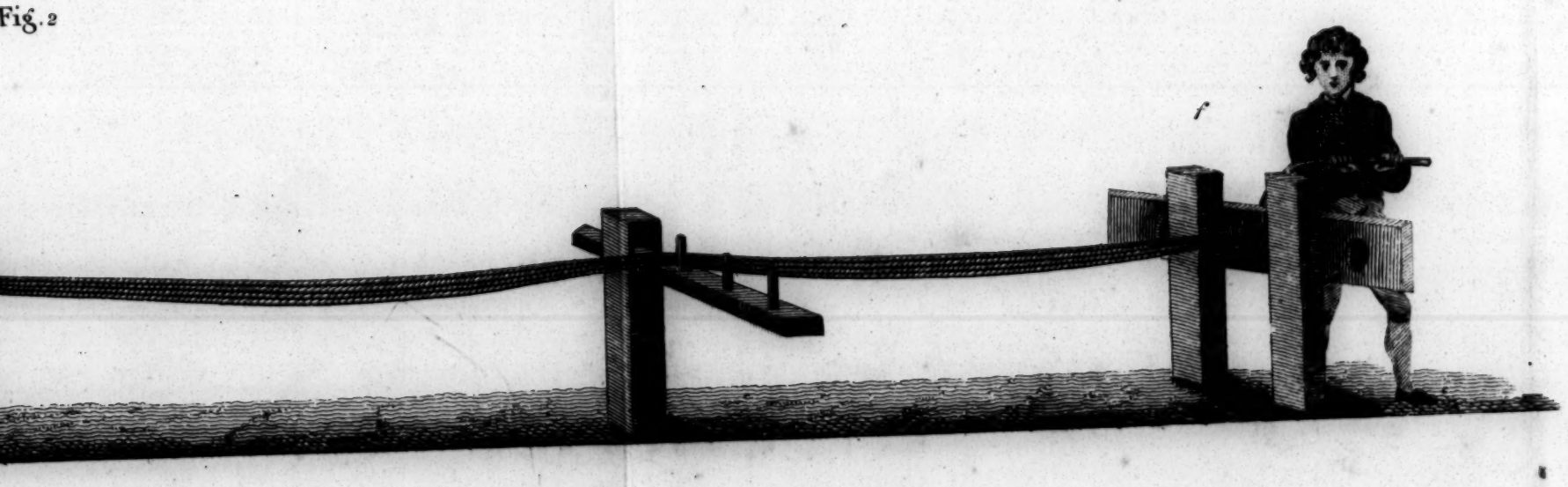


Fig.2



Veale sc. Strand

Plate 3

Fig. 1

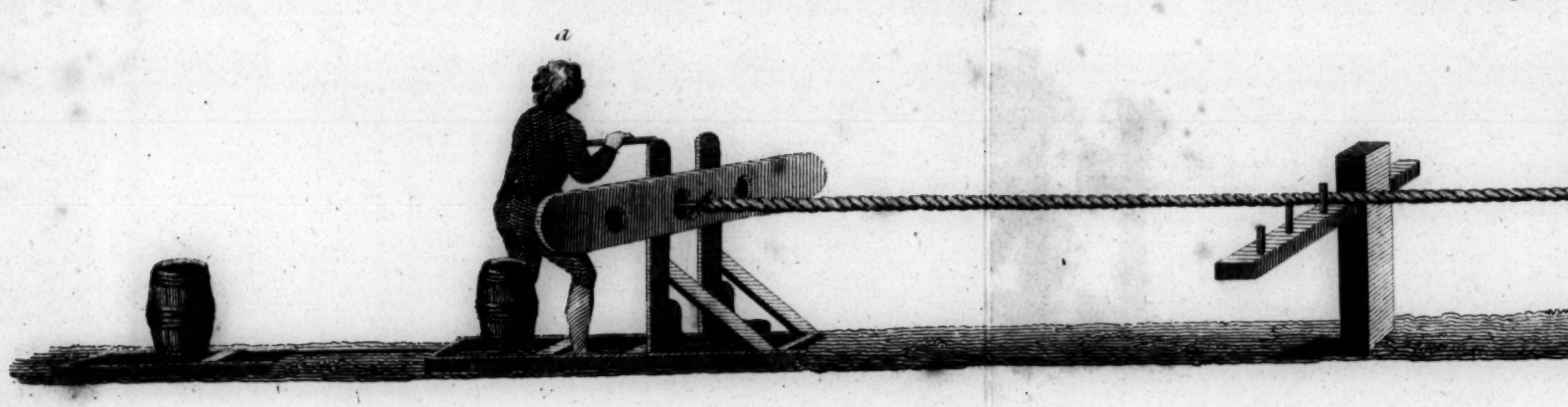


Fig. 2

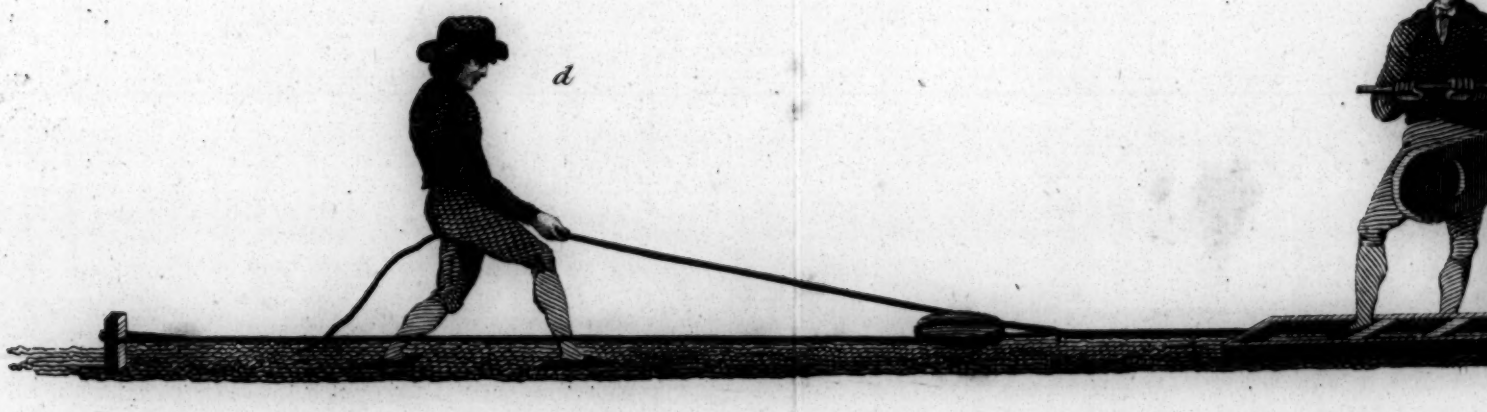


Fig. 1

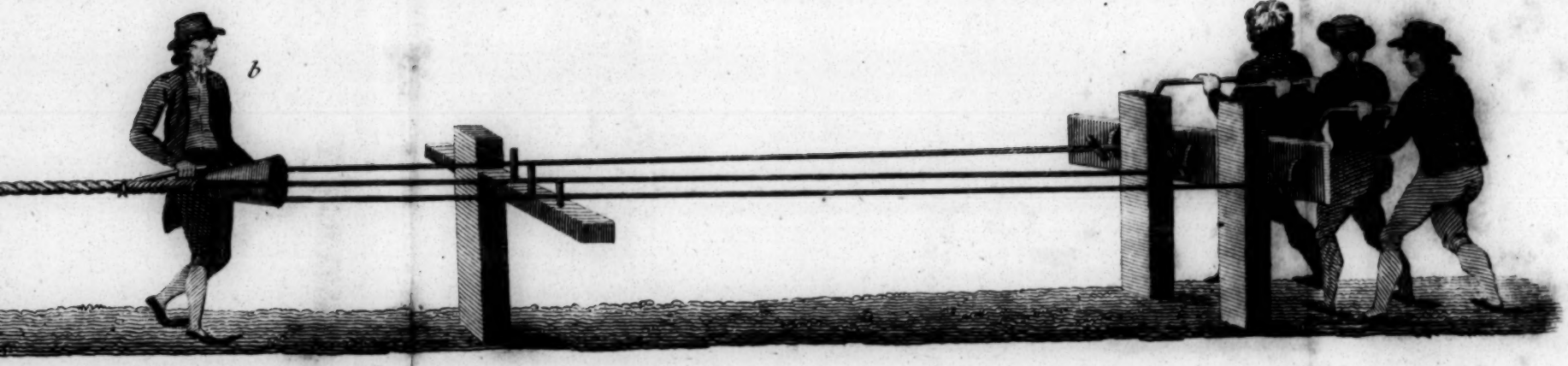


Fig. 2

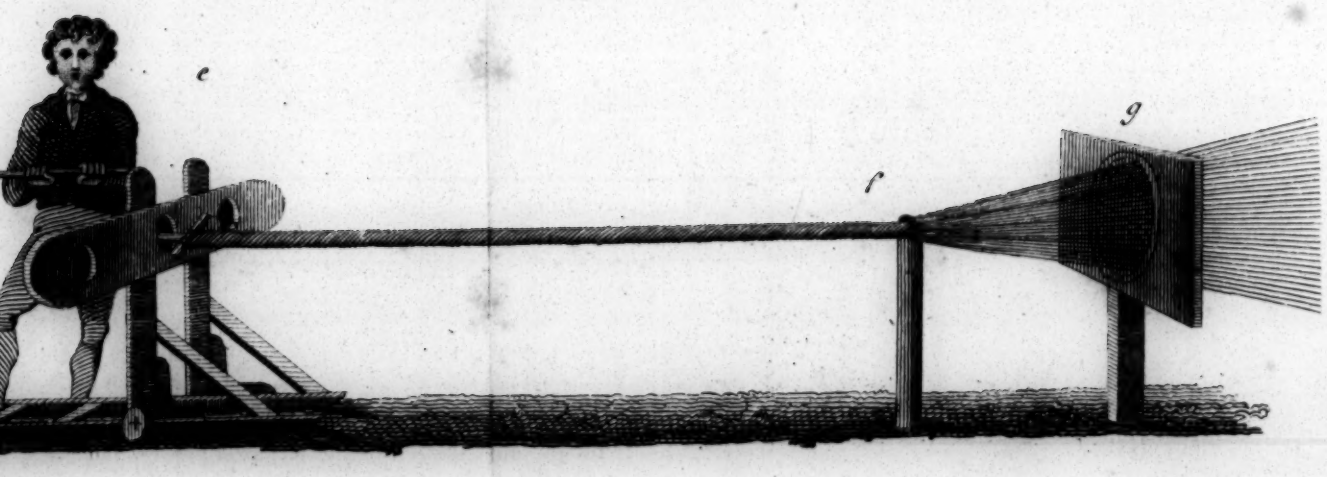


Plate 3, *Fig.* 1, is here ſhewn to manifeſt the natural properties, required in the ſeveral ſtrands or parts, to make them adhere. The figure *b* commenced its proceſs at the two moveable poſts or ſledge *a*, the ſtrands being firſt contracted, and hove up to the full *hard*, each on its own axis, in the ratio of 166 fathoms and 4 feet to 133 fathoms and 2 feet,* being one fifth; their full contraction. The re-action gained in that ſpace, 33 fathoms 2 feet, was gradual and progreſſive. The three powers at *c*, are for the purpoſe of keeping up the re-action; whilſt the figure *b* advances from the firſt point of contact, which commenced at *a*, proceeding with it, as it appears at *b*, towards *c*. This re-action of the twiſts, or parts, generates an adheſion which unites them; whilſt the power at *a* aids the proceſs by a circular movement; and the moveable poſts, or ſledge, ſlide on as the ſpirals contract the rope: the caſks, or preſs barrels, being filled with denſe matter, to govern the motion of the ſledge, according to the weight or perpendicular preſſure.

Plate 3, *Fig.* 2, exhibits the Syſtem defined WINDING. The yarns, or diviſions, paſs through a number of holes ſurrounding a center one, forming in progreſſive radii, as before deſcribed. 'Tis manifeſt that the cylinder thus produced is nearly dormant, and with little more re-action than to unfold itſelf.† Recourſe is then had to circular turn on its axis, with powers as deſcribed in the preceding Plates. The ſpirals being already formed, ſhorten the contraction that is to be gained by circular turn at the extremities; which circular turn, in the ordinary mode of contracting the twiſt, will be in the ſpace of 33 fathoms, 2 feet, (as before obſerved,) from which deduct the ſpiral or neutral contraction of this Syſtem

* For cables of 100 fathoms, being the length uſed in His Majeſty's Navy.

† Re-action is not to be obtained without a repelling power. If the circular turn is from the one extreme, the repulſion will be at the other; if the circular turn is from both ends, the repelling point will be between them.

Syſtem or mode, 23 fathoms, 2 feet; leaves ten fathoms for the ſpace to gain *reſiſting contraction.**

Plate 4, *Fig.* 1, and 2, ſhews the upper end of a ropewalk, with the method in common uſe, and the SALVAGEE, or ſubdiviſion method; each unravelled, or *hove out*, by the powers *a*, *a*, *a*, and *b*, *b*, *b*, after having undergone the uſual contraction. They are introduced only to exhibit the contraſt.

* I ſpeak from obſervation in two inſtances, in which the re-active contraction was obtained in a ſhorter ſpace. The natural properties required in the manufacture of cordage are at variance with each other. Nature is governed by laws; they muſt be followed, not forced: all that can be obtained is a MEDIUM. From what has come within my notice of the practical part of this Syſtem, or mode of manufacture, it appears, that the neutral ſpirals ſhould be more acute; that the reſiſting contraction (which can alone generate adheſion) being gained in a more lengthened ſpace, might be rendered more gradual and progreſſive.

I muſt apologize for this obſervation to the Patentees and Conductors of this Syſtem. To ſuggeſt what appears to be an improvement, is my motive for inſerting this obſervation; if in error, I intreat their pardon.

Vide Addenda

Plate 4

Fig.1

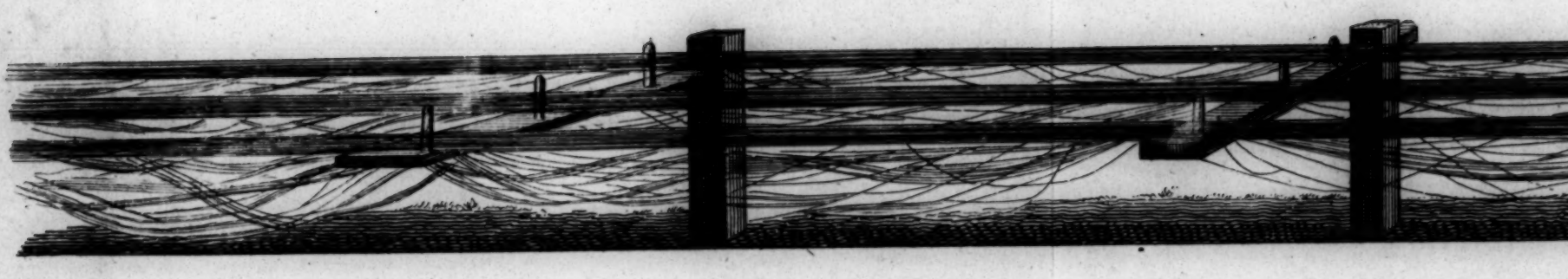


Fig.2

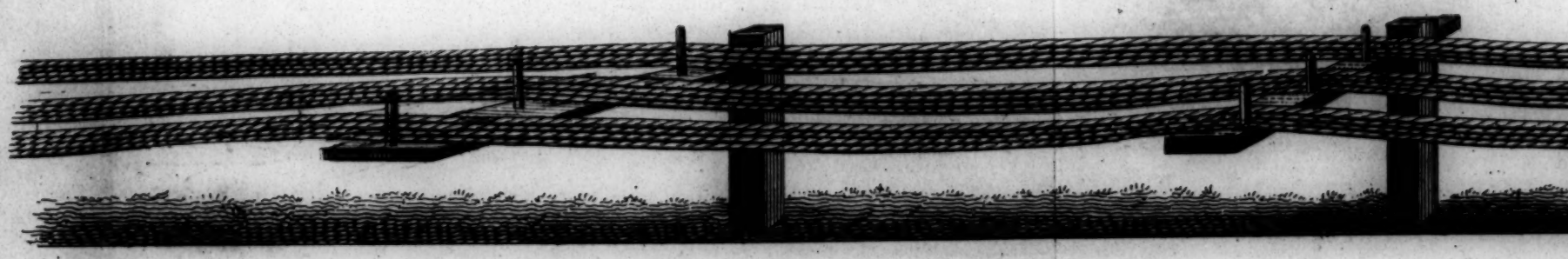


Fig. 1

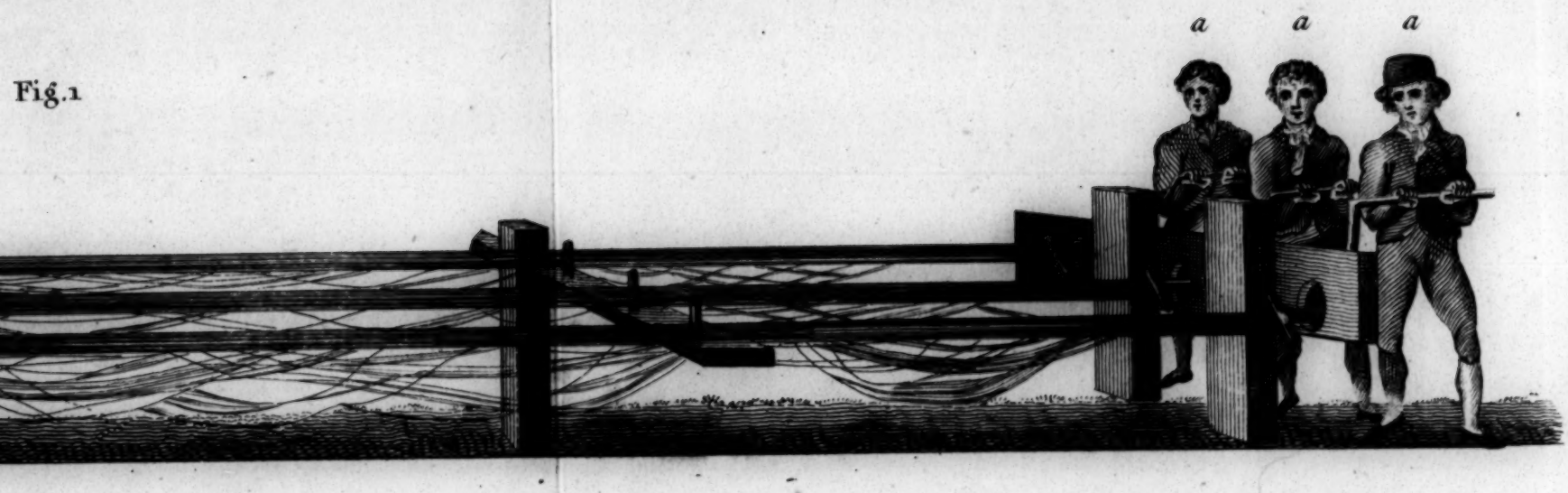
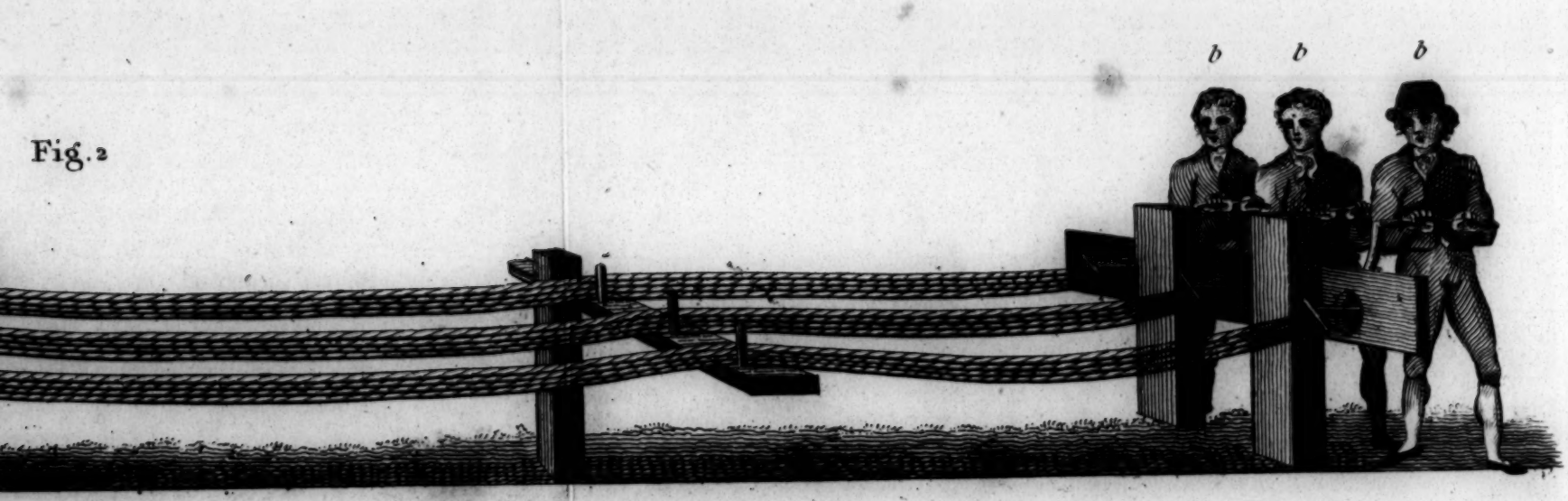


Fig. 2



Specification of the Patent granted to Mr. JAMES MITCHELL, *of the Hamlet of Poplar and Blackwall, in the County of Middleſex, Ropemaker, for a Method of manufacturing Cables, Hawſers, or Shroud-laid Ropes, and other Cordage, on a ſcientific Principle.*

WITH A PLATE.

Dated July 22, 1799.

TO all to whom theſe preſents ſhall come, &c. Whereas IT IS WELL KNOWN, that cables, hawſers, and other cordage of magnitude, have been manufactured on erroneous principles; that in the twiſt of a cable, or the ſtrand of a rope, the external yarns circumſcribing large circles, and the internal ſmall circles, were productive of unequal bearings, and conſequently that a cable, or large rope, had many yarns that did not act with the others. Nothing can exhibit this error more than crane ropes, eſpecially thoſe uſed at ſtone wharfs, where ponderous weights are to be raiſed, that will try their ſtrength, and alſo their property of reſiſting friction: theſe ropes, it is well known, always become ragged; the outſide yarns break, and exhibit a porcupine appearance. It is alſo well known, that cables, and other large ropes for nautical uſes, have their external yarns broke, and their internal ones freſh and unſtrained. How it has happened, for ages paſt, that this error, in a manufactory of ſo much conſequence, has continued, is not my preſent enquiry; but this error will, I truſt, be remedied in future by the preſent diſcovery. It lies in the root or commencement of the proceſs for manufacturing cordage; that is, in the cylindrical twiſt or one-ninth part of a cable, the cylindrical twiſt or one-third part of a hawſer-laid rope; and the error increaſes as the girt of the rope increaſes, or as the component parts become more numerous: To remedy this error is the object aimed at. Having paid great attention to this ſubject, I have diſcovered, to demonſtration, the ſuperiority of a different proceſs, by ſubdividing the twiſts or cylindrical parts

of

of cables, hawſers, and ropes of large dimenſions, and giving them a peculiar turn, ſo as to make them blend and unite; and alſo operating in ſuch a manner that the component parts act in ſpiral directions, nearly approaching to parallels; and the rope, when thus made, acquires an increaſed tenſion, from the yarns all bearing together; and alſo combines every other property required, ſuch as reſiſtance of fluids and friction; and that it acquires alſo a more uniform elaſticity. Such diſcovery being acted upon, will become not only of national utility, but univerſally ſo: inducements that have prompted me to apply for letters patent, that I may have ſuch benefit as may be reaſonably expected to accrue from a diſcovery of ſo much importance; and, that it may be hereafter manifeſt to whoſoever may require information for that purpoſe, the following directions, with the annexed plan, will exhibit the proceſs. Now know ye, that in compliance with the ſaid recited proviſo, I the ſaid James Mitchell do hereby declare, that the nature of my ſaid invention, and the manner in which the ſame is to be performed, is particularly deſcribed and aſcertained as follows: that is to ſay: The yarns are to be ſpun and laid horizontally in parallels, as uſual, the full length intended; then let the number required for the cylindrical twiſt, or one-ninth part of a cable, the cylindrical twiſt or one-third part of a hawſer, or twiſt of any other kind of rope, be divided into two, three, four, or more equal parts; turn the ſubdivided twiſts, at the extremities, with the ſun, by means of a table-wheel and back frame, or otherwiſe by means of the tackle-board and ſledge, until the turn ſhall meet in the centre; then abate the turn at the ends, and render the whole as nearly alike as poſſible, taking care that each one ſhall be a ſeparate and diſtinct column or twiſt; repeat the ſame in all the numbers of ſubdivided twiſts required, which, for diſtinction, I name ſelvagee twiſts; (ſelvagee twiſts are of two ſorts; the proper one conſiſts of ſeveral rope-yarns turned into a circular form, and marled together, Plate V. Fig. 3. the hand ſelvagee is the twiſt or ſtrand of a rope with the turn abated, and then knotted, Fig. 4;) bring together two, three, four, or more of theſe ſeveral ſelvagee twiſts, (as may be required for the ſtrand

of a

of a rope, or twiſt of a cable,) at the extremities, by putting them on a forelock, or nebhook; at each end turn theſe hooks with the ſun, as before, and unite all the parts into a cylindrical form, acting with preſs, as uſual, and reduce or contract this cylindrical twiſt or ſtrand, by turning the hooks or cranks, until it is ſhortened from one-eighth to one-ſixth, as the compreſſion will be found to vary from rope made in the uſual way, and then the twiſt required will be obtained: proceed with the remainder of the proceſs in the uſual mode or way. When finiſhed, it will be perceptible, that the yarns in the twiſts of large ropes, inſtead of circumſcribing circles of irregular and various diameters, which is the cauſe of unequal bearings, will, by theſe ſubdiviſions, circumſcribe ſmall circles, of more equality; that the component parts or threads act together in lengthened ſpirals, nearly approaching parallels; and it will be viſible, and convincing, that the rope acquires ſufficient hardneſs or compreſſion to reſiſt fluids and friction; and, on trial, will be found with increaſed tenſion or ſtrength, and a more uniform elaſticity: and this proceſs applies to white as well as tarred ropes, as all deſcriptions of cordage are to be made in this manner, with or without tar. This manufacture is ſtrikingly diſtinguiſhed from every other mode yet made uſe of, or invented. Hitherto, cable-laid cordage has been compoſed of nine cylindrical twiſts, and hawſer-laid cordage compoſed of three cylindrical twiſts, (four ſtrand ropes excepted, which can alſo be made on this principle.) By the preſent invention, cable-laid cordage is compoſed of eighteen, twenty-ſeven, thirty-ſix, forty-five, fifty-four, ſixty-three, ſeventy-two, cylindrical parts or twiſts, which, for diſtinction, I name ſelvagee twiſts, (from their reſemblance to a hand ſelvagee,) or any number of them multiplied by nine; and hawſer-laid cordage is compoſed of ſix, nine, twelve, fifteen, eighteen, twenty-one, cylindrical parts or twiſts, called alſo ſelvagee twiſts, or any number multiplied by three. The turn in the ſelvagee twiſts is peculiar to this manufacture, acting with each other, inſtead of reverſing, ſo as to make them bed and unite, whilſt the cuſtom hath hitherto been to reverſe the turn in every part of the proceſs. Theſe cylindrical twiſts are not procured by the act of winding, or ſo placed as to deprive them of their full re-active

power, without which, rope of every deſcription muſt be defective; but they retain their full re-action, unite and blend the parts ſo as to reſiſt fluids, ſtand friction, acquire a more uniform elaſticity, and make the whole of its component parts have equal bearings, or very nearly ſo; and it can be demonſtrated, that any one, of leſs girt or circumference, is equal in ſtrength to one made in the common way, of an increaſed girt or circumference. The equal bearings may be ſhewn by the ſelvagee twiſts, which cannot be diſturbed by any ſubſequent part of the proceſs throughout the whole operation, as may be made to appear by taking three, four, or more parts, (that compoſe the whole twiſt,) in the hand, making therewith a circular movement; or by reſtoring the twiſt to parallels, as when the operation firſt commenced. On the whole, the preſent improvement is manifeſt, on view, both to the ſcientific world and every beholder.

The annexed Engraving (Plate V.) illuſtrates the proceſs, and exhibits the cable in all its parts.

Fig. 1. The ſelvagee twiſts *b*, *b*, &c. are repreſented as taken from the table-wheel and backframe, and ſtretched in parallels, with a temporary faſtening, between the poſts *a*, *a*.

Fig. 2. A. The cable. B, B, B, the cable ſtrands. *c*, *c*, *c*, the twiſts which compoſe the ſtrand. D, D, D, the ſelvagee twiſts, or ſubdiviſions, which are united in that twiſt.

Fig. 3. repreſents a marled ſelvagee, uſed for ſetting up rigging, &c. &c.

Fig. 4. repreſents a hand ſelvagee, which is the ſtrand of a rope, with the turn abated, and then knotted, and uſed for the ſame purpoſes as the marled ſelvagee. Theſe ſelvagees are remarkable for their great ſtrength, which is the reaſon why rope made on the new principle is called ſelvagee cordage. In witneſs whereof, &c.

Fig. 1.

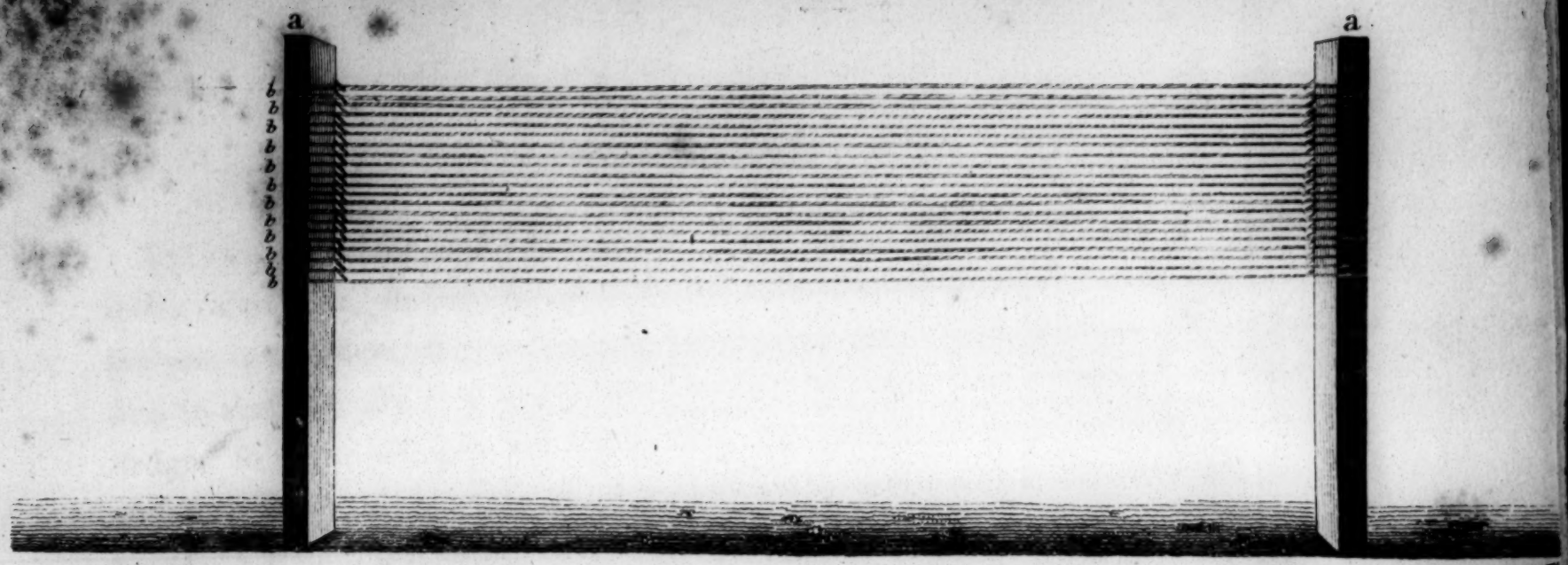


Fig. 2.

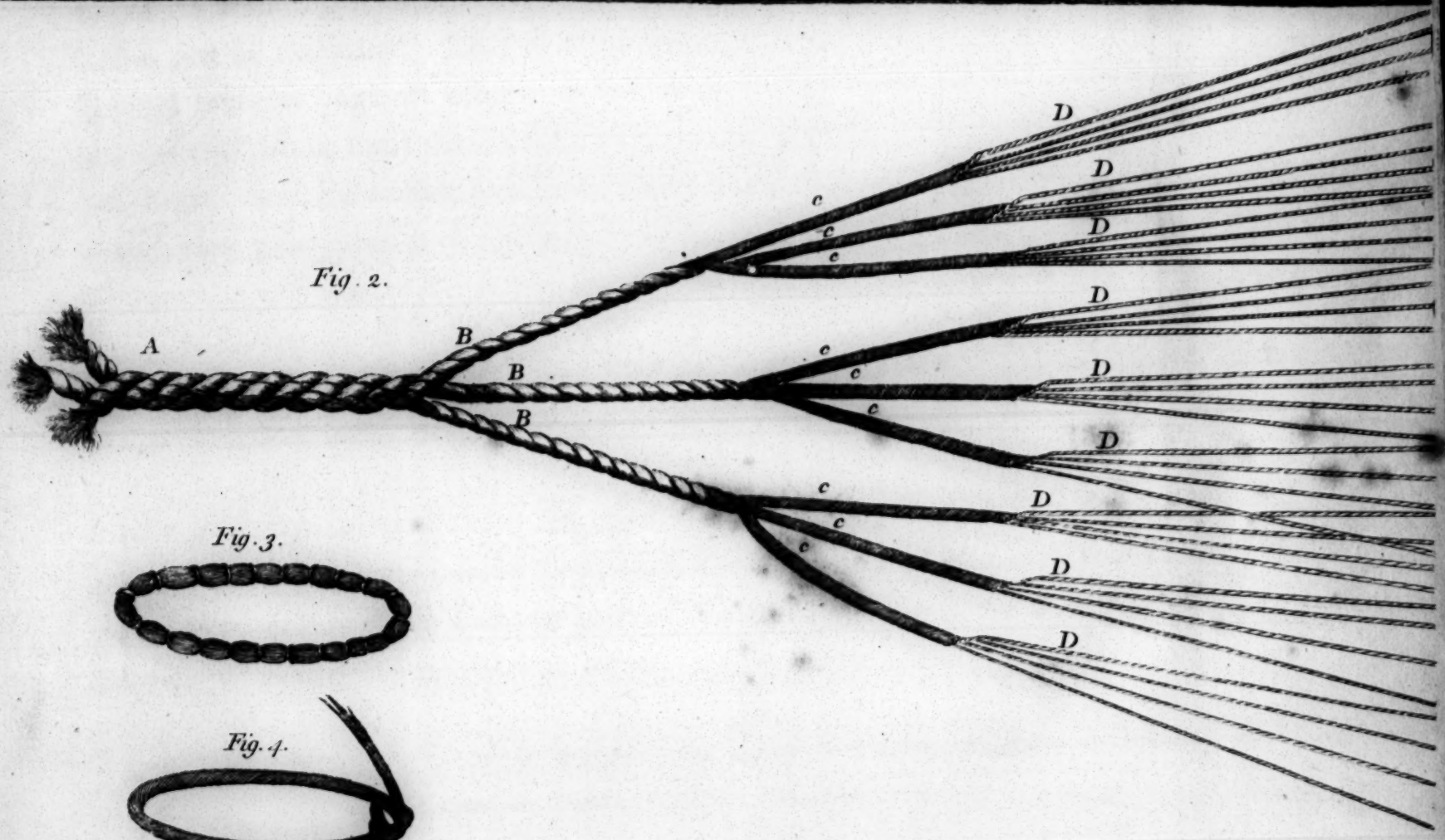


Fig. 3.

Fig. 4.

A. _ _ _ _ _ *The Cable*

B.B.B. _ _ _ *Strands of the Cable*

c. c. c. _ _ _ *Twists or Divisions of the Strand*

D.D.D. _ _ _ *Selvagee Twists or Subdivisions*

a. a. _ _ _ _ *Posts or Stanchions*

b. b. b. _ _ _ *The Selvagee Twists stretch'd in Paralleles as prepared for the Cable*

Fig. 3. _ _ _ *Proper Selvagee*

Fig. 4. _ _ _ *Hand Selvagee*

CONCLUSION.

TRIAL muſt be the final teſt. In the infant ſtate of this new Syſtem, the only mode reſorted to, in order to aſcertain the difference of tenſion between this and the one in common uſe, has been by heaving up the ſtrands or twiſts of various ſizes to their accuſtomary *hard*, then abating the turn, and drawing back the ſledge, ſo as to diſcover the yarns that did, and thoſe that did not, act together. The reſult has proved, that there are as many acting together in a cable of 15 inchcs girt in the one, as there are acting together in a cable of 17 inches girt in the other. Trial of large ropes, by ſuſpenſion of weights, or horizontal tenacity, againſt others, is not eaſily in the power of an individual: but the trial which muſt decide the merits of each Syſtem, will be by their nautical uſes; and by raiſing and lowering of ponderous property from Cranes. TIME, that great umpire of doubtful events, muſt be reſorted to with patience. Whenever this Syſtem ſhall come into common uſe for a few years, the mariner will beſt determine:* to his judgment will be the final appeal. And I truſt that this Syſtem, adopted by SUBDIVISIONS, the theory of which has hitherto met with approbation, will in the end be confirmed by experience.

If this invention ſhould have the good effect of ſaving from deſtruction only a ſingle ſhip and crew of ANY NATION whatever, it will be a mental gratification beyond any thing I am competent to expreſs; but I ardently hope, and believe, it will be the ſalvation of many.

* Becauſe a Combination of various Properties are required: Tenſion, Pliability, Elaſticity, Reſiſtance of Fluids, Friction, and Durability.

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ADDENDA.

THE WINDING SYSTEM embraces, within the Periphery of its Circumference, or Girt, more Yarns than are contained in one made in the common Way; the Girt being diminiſhed in conſequence of the internal Yarns being ſhortened in the Proceſs. The Proportions they bear to each other, are in the Ratio of the Squares of their reſpective Girts, and will be nearly as follows:

If the Reduction in the component Parts is	The Contents of a Cable of 11 Inches in the one will be equal to - - -	in the other.
$\frac{1}{5}$	Inches.	
$\frac{1}{6}$	$12\frac{1}{4}$ *full*	
$\frac{1}{7}$	12 *full*	
$\frac{1}{8}$	12 *bare*	
$\frac{1}{9}$	$11\frac{3}{4}$ *full*	
$\frac{1}{10}$	$11\frac{3}{4}$ *bare*	
	$11\frac{1}{2}$	

☞ This Circumſtance ſhould be adverted to on Trials of Tenſion.